

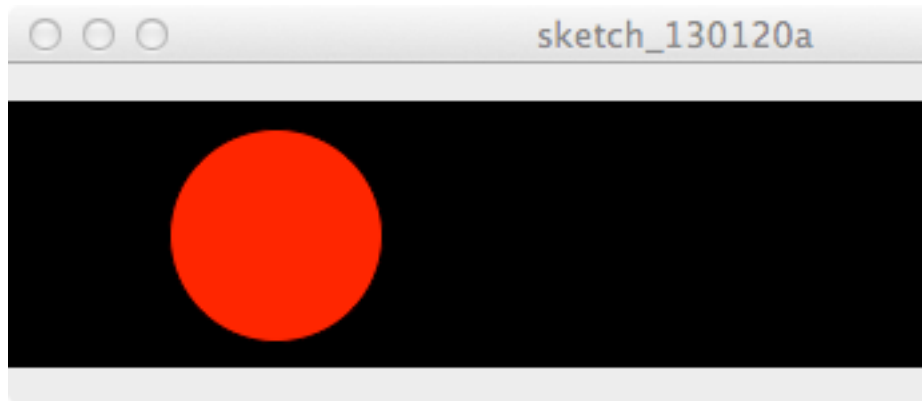
Changing Control

Testing and Repetition

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Let's Begin W/ Idea From Last Lab

- We saw how to change the color of the ball and its direction with a mouse & key clicks
- Recall



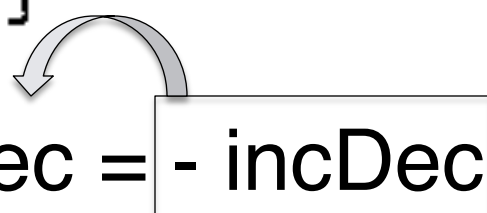
```
void keyPressed ( ) {  
    incDec = - incDec;  
}  
void mousePressed( ) {  
    int temp;  
    temp = bPos;  
    bPos = gPos;  
    gPos = rPos;  
    rPos = temp;  
}
```

First: Assignment (=) At Work

- Rule: Assignment always moves information from right to left, as in

```
void keyPressed ( ) {  
    incDec = - incDec;  
}
```

incDec = - incDec;



- Rule: Always evaluate (compute) the right side, then assign the result to the name on the left side ...

Expressions

- Facts about expressions
 - Expressions are formulas using:
 $+ - * / \% \parallel ! \&\& == < <= >= > !=$
 - Operators can only be used with certain data types and their result is a certain data type
 - Putting in parentheses is OK, and it's smart
- Rules about expressions
 - Expressions can usually go where variables can go

Expressions, the Picture

■ Facts

- Expressions are formulas: $a+b$ $\text{points} * \text{wgt}$
 $(\text{year} \% 4 == 0)$ $7 != 4$ $(\text{age} > 12) \ \&\& \ (\text{age} < 20)$
- “Need & give data types”
 - $+ - * / \% < <= == >$ want numbers;
 - $\&\& ! ||$ want logical (Boolean) values
 - $==$ and $!=$ want arguments to be the same type
- “Parentheses are good”: $(a * b) + c$ is the same as $a * b + c$, but easier to read

mod (%) is what's left after divide

- $a \% b$ (read, “a mod b”) is the amount left after “b divides into a evenly”

- Examples:

- $0 \% 3$ is 0

- $1 \% 3$ is 1

- $2 \% 3$ is 2

- $3 \% 3$ is 0

- $4 \% 3$ is 1

- $5 \% 3$ is 2

- $6 \% 3$ is 0

Even: a number n is even
if $n \% 2 == 0$

Leap Year: $year$ is a leap
year if $year \% 4 == 0$

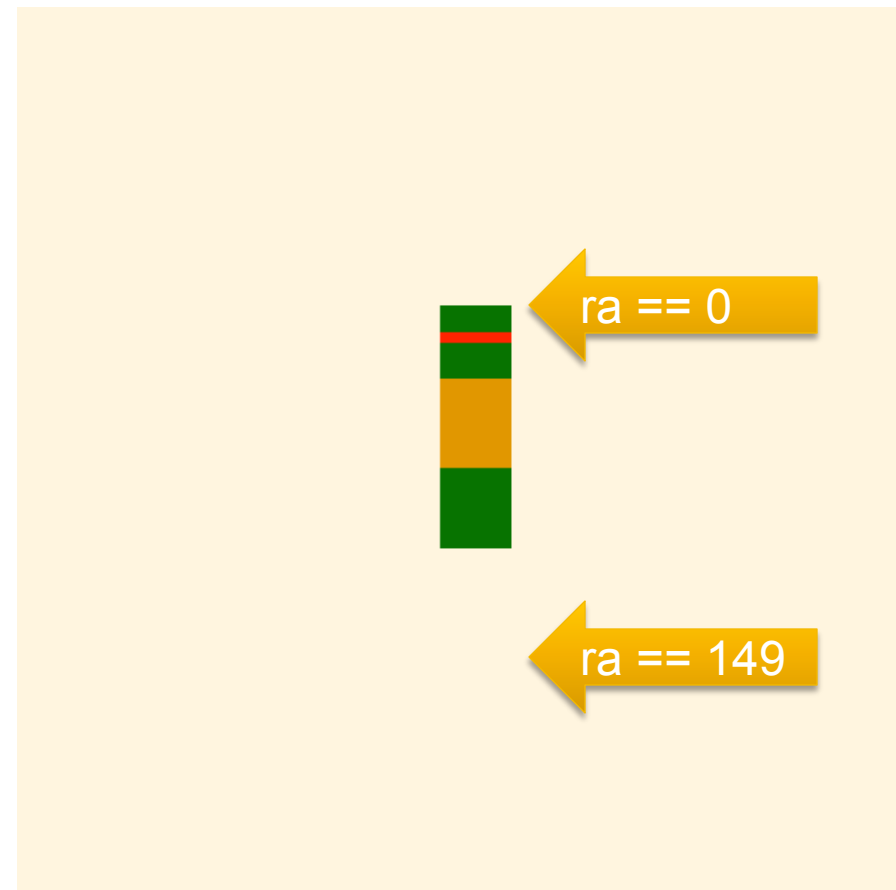
Asian Zodiac: $year1$ and
 $year2$ are the same sign if
 $year1 \% 12 == year2 \% 12$

Raff Jumps, Then Floats Down

- As numbers get larger, mod will cause them to “drop to 0” ... this is a Ninja move

Just Do It

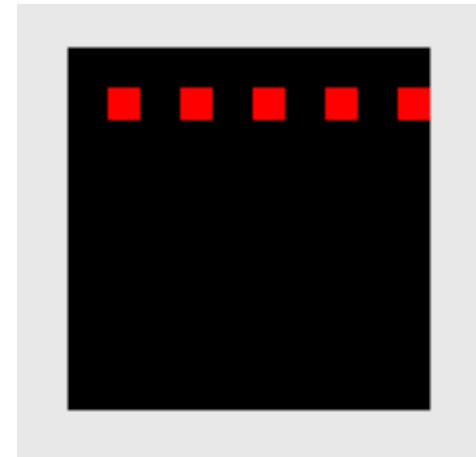
```
int ra = 0;
void setup( ) {
  size(500,500);
  noStroke();
}
void draw() {
  background(255, 245, 220);
  raff( );
  ra = (ra + 1)%150;
}
void raff( ) {
  fill(0,100,0);
  rect(240,260+ra, 40, 45);
  fill(219,136,0);
  ...
}
```



Repetition (or looping)

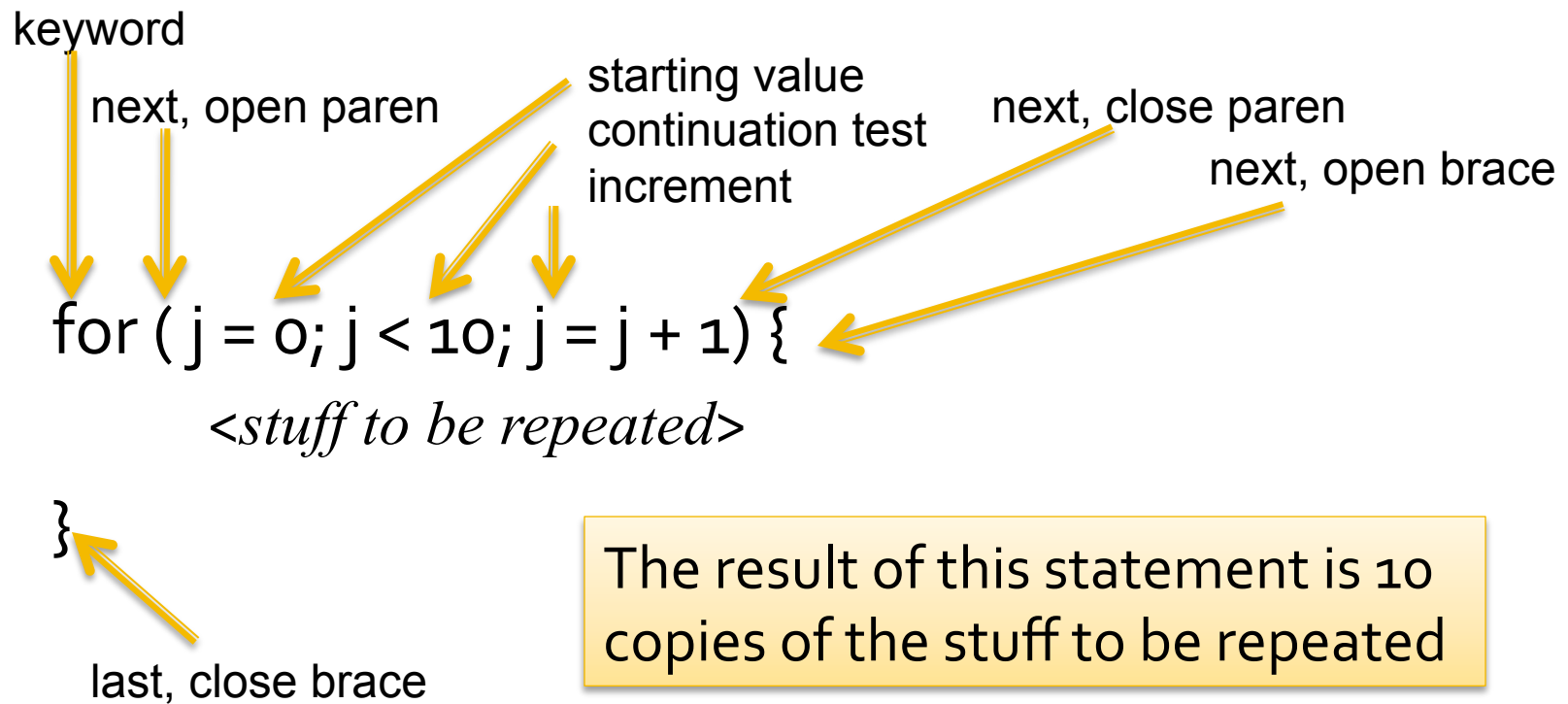
- Repeating commands is a powerful way to use a computer ... we could repeat them, but all programming systems have a way to loop:
 - Lightbot 2.0 used recursion, a function calling itself
 - Symbolic Lightbot prefixed a number, 2:Step
- Processing (and other modern languages) use a **for** loop:

```
for (i = 0; i < 5; i = i + 1) {  
    rect(10+20*i,10,10, 10);  
}
```



Repetition, the Picture

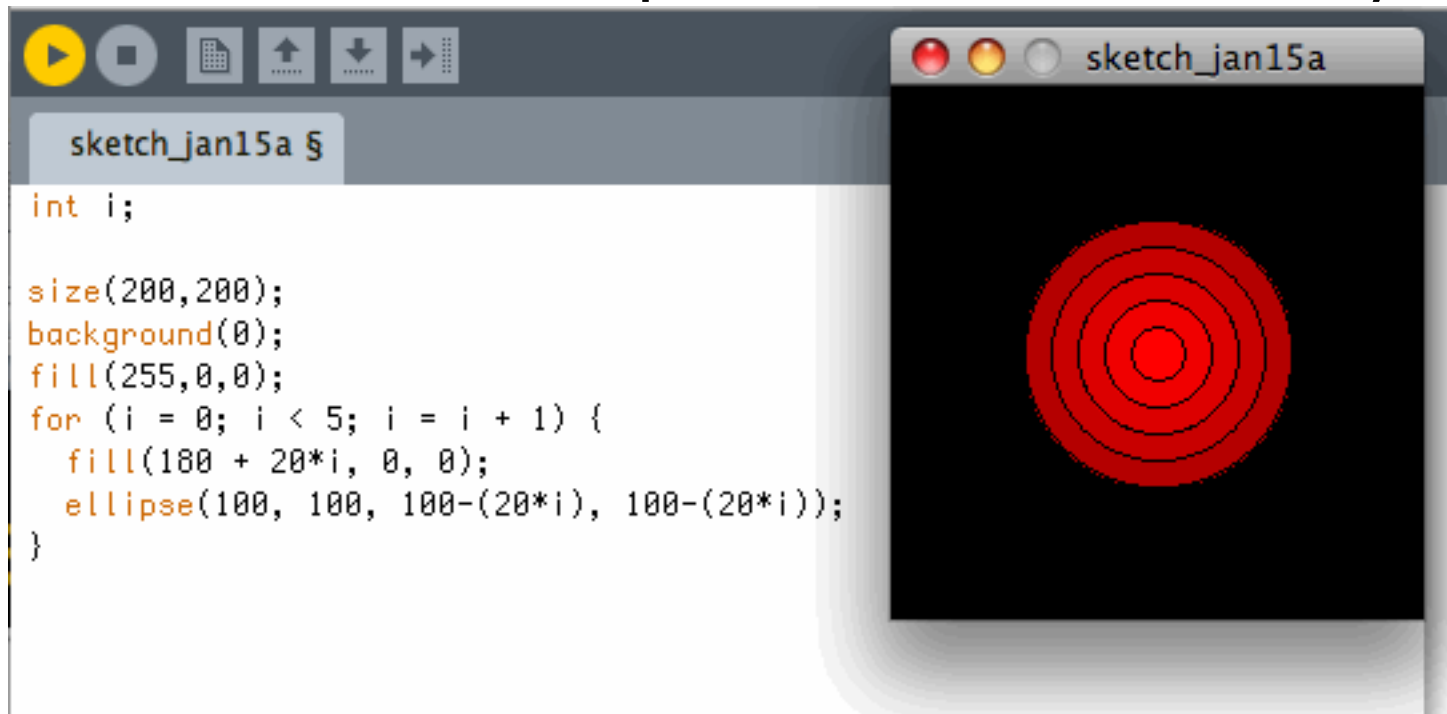
- A for loop has several parts, all required ...



Just Do It

Repetition, Another Picture

- As a further example, consider a bullseye



- Note the *loop variable* must be declared ...
could write: `for (int i = 0; ...`

Tests, A/K/A If statements

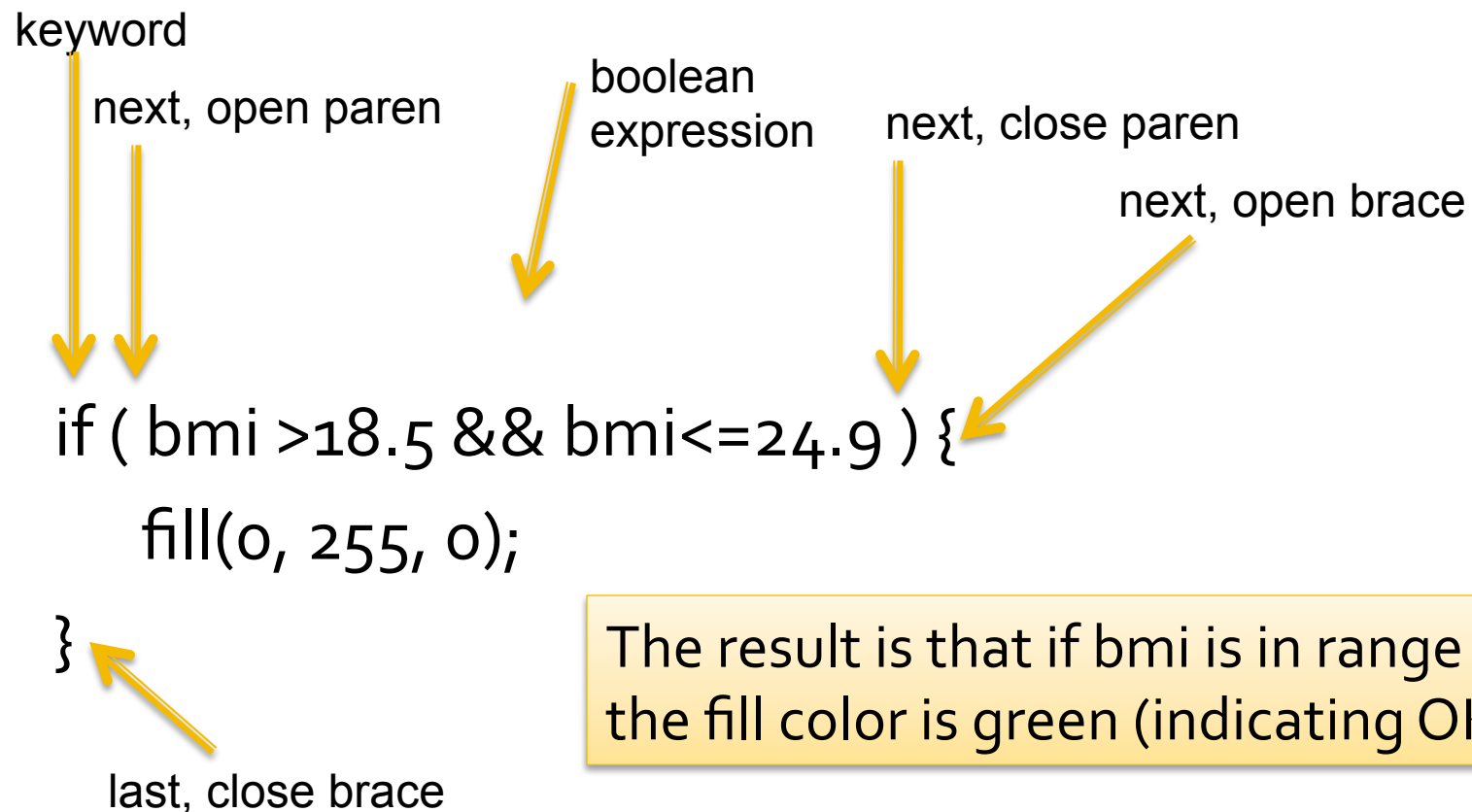
- The instructions of a program are executed sequentially, one after another ... sometimes we want to skip some: Say “Hello” to the **If**
- **If** also has a required form

```
if (year%4 == 0) {  
    <stuff to do if condition true>;  
}
```

```
if (chosen_tint != color(0,0,255)) {  
    fill(chosen_tint);  
}
```

Tests, the Picture

- An **If**-statement has a standard form



The result is that if bmi is in range the fill color is green (indicating OK)

Else Statement

- What happens if we want to do something else if the condition is false? What else? **else!**
- The **else** statement must follow an **if ...**

```
if (year%4 == 0) {  
    <stuff to do if condition true>; //Then Clause  
} else {  
    <stuff to do if condition false>; //Else Clause  
}
```

Else, the Picture

- The standard form may now be obvious

```
if (year%4 == 0) {  
    feb_days = 29;
```

Else must follow if
because it does the test

```
} else { ← open brace, immediately after “else”
```

keyword

```
    feb_days = 28;
```

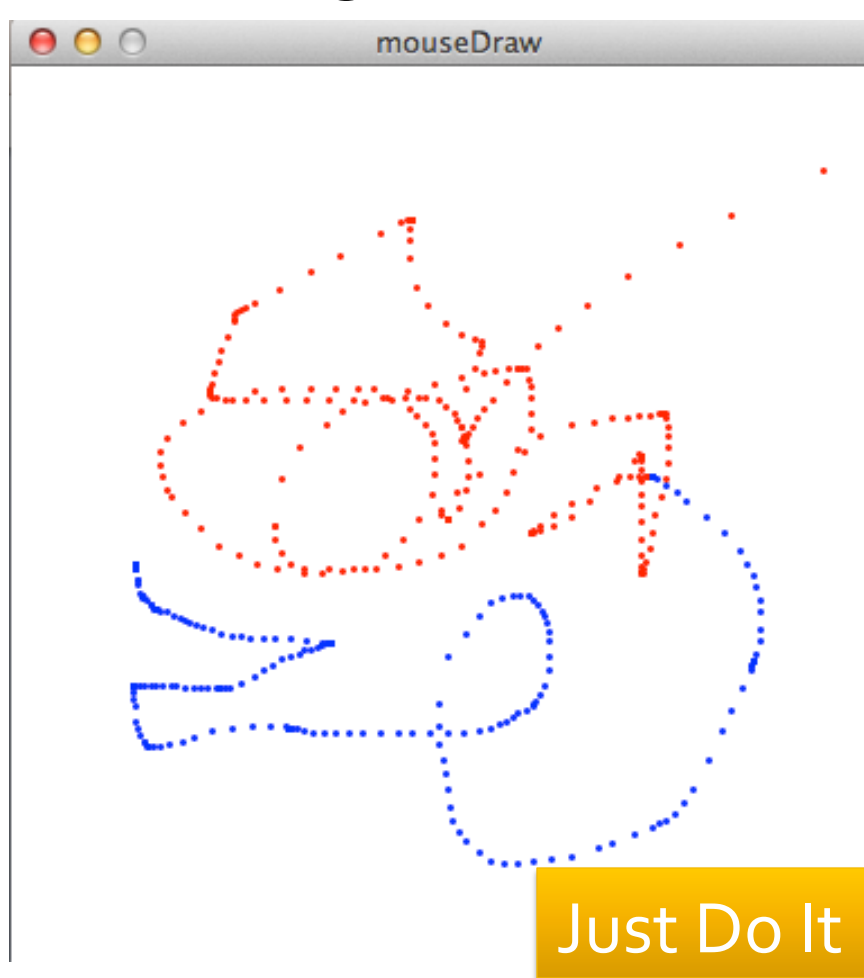
```
}
```

finally, close brace

The result is sets the number of
days in February based on leap year

If/Else, The Demo

- Let's go to processing for an example



```
void draw(){  
  ellipse(mouseX,mouseY,3,3);  
  if(mouseX<10 && mouseY<10) {  
    background(255);  
  }  
  if(mousePressed) {  
    fill(0,0,255);  
  } else {  
    fill(255,0,0);  
  }  
}
```

Writing Programs

- Naturally, programs are given sequentially, the declarations at the top
- Braces { } are statement groupers ... they make a sequence of statements into one thing, like the “true clause of an If-statement”
- All statements must end with a semicolon EXCEPT the grouping braces ... they don't end with a semicolon (OK, it's a rare inconsistency about computer languages!)
- Generally white space doesn't matter; be neat!